objection to formaldehyde is that it bleaches muscular tissue to an ashy gray. In the course of our investigation, this objection was found to be overcome by adding an alkali to the formaldehyde solution, thus changing its reaction from acid to alkaline. In the selection of the proper alkali it was found, however, that the common alkalis caused a deterioration of the formaldehyde after several weeks' standing. On account of the instability of formaldehyde in the presence of sodium hydrate, potassium hydrate, ammonium hydrate, sodium sulphite, and sodium carbonate they all had to be abandoned, whereas borax was found to furnish the desired alkalinity without causing more than the very slightest deterioration of the formaldehyde after having been made up almost three years. Borax has the additional advantage of being in itself a preservative.

Table showing the instability of formaldehyde after the addition of various alkalies and showing its stability in the presence of borax.

Aqueous solutions of formaldehyde rendered alkaline by the addition of—	Percentage of formaldehyde in the solutions after having stood—			
		6 weeks.		
Borax, sodium borate ($Na_2B_4O_7$)	Made up with approximately 5.5 per cent formaldehyde.	5.47		
Sodium carbonate (Na_2CO_3)	....do....	5.10		
Sodium sulphite (Na_2SO_3)	....do....	4.25		
Ammonium hydrate (NH_4OH)	....do....	2.15		
Sodium hydrate (NaOH)	....do....	0.90		
	1 day.	4 weeks.	10 weeks.	2 years 8 months.
Sodium carbonate, 1 per cent	5.11	4.87	4.72	4.59
Sodium carbonate, 2 per cent	5.10	4.78	4.58	4.22
Sodium carbonate, 3 per cent	5.09	4.76	4.50	3.85
Sodium carbonate, 5 per cent	5.09	4.69	4.38	3.57
Sodium carbonate, 10 per cent	5.09	4.61	4.24	3.12
Borax, 3 per cent	5.14	5.05	5.02	5.00
Borax, 5 per cent	5.11	5.07	5.00	.98

The determinations of the amounts of formaldehyde were made by Elias Elvove, technical assistant, Hygienic Laboratory, United States Public Health Service.

PARALYSIS DURING ANTIRABIC TREATMENT.

REPORT OF TWO CASES OF PARALYSIS, WITH ONE DEATH, OCCURRING DURING THE COURSE OF ANTIRABIC TREATMENT.

By H. E. HASSELTINE, Passed Assistant Surgeon, United States Public Health Service.

In the Public Health Reports [1] of October 24, 1913, the author reported two cases of paralysis occurring during the course of antirabic treatment.

[1] Hasseltine, H. E. Public Health Reports, 1913, vol. 28, pp. 2220-2225.

In that report appears the statement that this paralysis is said not to occur after treatment according to the dilution method of Högyes; this should be modified to read that reported cases of this paralysis have been least frequent when this method was used. The author found three reported cases in patients treated by the dilution method.

Since that report was submitted two other cases of paralysis have been seen, one of which resulted fatally, and of which the following are the case histories:

CASE 1.—Male, age 52, printer, weight about 200 pounds; an inveterate user of tobacco; denies use of alcohol to excess.

Bitten on right hand and arm and on left leg by a probably rabid dog. Wounds cauterized by his physician one hour after infliction; the agent used is not known. Began antirabic treatment the following day at the Hygienic Laboratory, and completed the course according to the usual scheme (24 injections in 21 days). The patient went to and from his home, a distance of about 12 miles, by trolley and had several minutes' walk from his home to the station. On the last day of the treatment he was exposed to a strong, cold wind, and two days later developed right-sided facial paralysis. He felt slight pain in the face, but considered it neuralgia until he noticed trouble in expectoration.

The following day the left side of the face showed paralysis, with ptosis of both eyelids. No other symptoms developed; the facial paralysis slowly recovered, the recovery being complete in about three weeks.

Since then the author has seen the patient on the street on several occasions and verified the recovery. On practically each of these occasions he had been indulging freely in alcoholic beverages, and the author believes that the assumption is warranted that alcoholic excess may have been a contributing factor in the development of his local paralysis.

CASE II.—Age 47; male; white; weight about 180 pounds; robust in appearance. Leads an active life, doing a large amount of walking and bicycle riding. Habits as regards use of alcohol are claimed to be temperate, but later a physician, who knew him personally, said that he had been a heavy drinker in past years.

While on the street he was bitten by a fox terrier, the ownership of which was not known. The wounds consisted of several punctures on the outer side of the left thigh, a few inches above the knee. The wounds were cauterized with nitric acid by the author at the Hygienic Laboratory about 30 minutes after infliction. The dog was killed shortly after biting the patient, and examination of the brain showed the presence of Negri bodies.

Antirabic treatment was begun at the Hygienic Laboratory four days after the bite was inflicted. On the seventh day of the treatment a slight local reaction at one site of injection was noted. On the eighth day, the local reaction was moderate at two sites of injection; on the ninth day, severe local reaction was present at two sites. On the tenth and eleventh days, moderate local reaction at two sites of injection was noted.

On the twelfth day of the treatment (16 days after being bitten) he did not report for treatment and on the following day it was learned that he was ill at his home.

He was visited on the thirteenth day after beginning treatment by Asst. Surg. C. L. Williams and the author, and the following data obtained: He stated that about 1 p. m. on the eleventh day of the treatment (the day he received his last injection) he was taken sick with vomiting, pain in the abdomen, and pain in the lumbar region

of the spine. That night he suffered from chilly sensations and also had some fever. On the twelfth day his fever continued and he had chills at intervals, but did not vomit. On the thirteenth day, the day of our first visit, he had no chills but said he felt warm. No attempt was made to obtain a complete family and previous history as the patient was too ill to be disturbed unnecessarily.

Physical examination.—Temperature, 39° C.; pulse, 80; respiration, 20.

Pulse regular and of good volume; respiration, diaphragmatic. Tongue, very much coated and breath foul.

Patellar, cremasteric, and abdominal reflexes absent. Sensation absent to the level of the diaphragm on the left side and to the level of the knee on the right side. Blood examination shows no malarial parasites and a slight leucocytosis (11,820 per cu. mm.), which the author attributed to the fact that sufficient blood could be obtained only by compressing the finger.

At noon of the fourteenth day after beginning of treatment he was visited by his attending physician, Asst. Surg. Williams, and the author. Temperature, 36.2° C.; pulse, 64; respiration, 18. Sensation was absent to the level of the diaphragm on both sides and the muscular power in the arms was impaired. The right arm was involved more than the left, the patient being able to flex the fingers of the right hand, but unable to extend them. In the left upper extremity flexion of the fingers was good, but extension of the same was weak. The movements of the elbows and shoulders were normal. Sensation was lost on the extensor surface of the right forearm and hand; also on the dorsal surface of the left hand. He complained of pain in the cervical portion of the spine. His mental condition was clear and he talked naturally. He stated that he passed a restless night and felt that he had some fever. He complained of thirst and drank freely. Urination had been normal until the morning of the fourteenth day; since then the urine had been passed involuntarily at frequent intervals. Catheterized by his physician and about 1,500 cc. of clear urine obtained. A specimen of this was examined by Dr. Williams and found normal. The tongue remained coated. Vomiting absent for the past three days. Defecation was involuntary.

Visited by the author on the fifteenth day after beginning of treatment and six days after the beginning of symptoms. He was conscious and recognized me when I entered the room. His face was somewhat cyanosed and there was a slight gurgling of mucus in the throat. Speech rather thick and difficult. Respiration, diaphragmatic but shallow. Pulse taken and found to be of good volume and regular; rate, 72 per minute. Before the rate of respiration could be counted he suddenly stopped breathing. Artificial respiration was instituted at once and the heart continued to beat for a few minutes, but about 15 minutes after the collapse occurred all signs of life had disappeared. An autopsy could not be obtained to determine the presence or absence of rabic infection.

The question at once arises, Was this not a case of paralytic rabies instead of so-called treatment paralysis? It is within the range of possibility that the case was rabies resulting from infection received at the time of the bite. However, for a bite on the lower extremity of a male adult, an incubation period of 14 days is exceptionally short, this being practically the minimum incubation period in cases where location of bite, age, sex, and other conditions are most favorable to a rapid development of rabies. This patient showed no excitement, no hypersensitiveness to any kind of stimulus, and no difficulty in swallowing. In fact, he drank profusely during the last two days of illness. Several animals were inoculated with an emulsion made from a towel that was soiled with the patient's saliva and

none developed symptoms of rabies. On the other hand, the symptoms followed quite accurately the course described by most writers who have reported cases of this paralysis.

The cases reported in literature vary from a transient local paralysis of one or more nerves to an acute, rapidly ascending paralysis which is fatal in a comparatively large percentage of cases.

A case was reported by Babes [1] and Mironescu in which autopsy was obtained and the absence of rabic infection determined as follows:

A woman, age 42, was bitten September 9, 1907, by a dog subsequently proven to be suffering from rabies, sustaining deep multiple bites upon the hands. She began treatment on September 14. Her medical history disclosed a tendency to neurasthenia and moderate alcoholism. On September 25 she was taken sick with headache, coated tongue, gastric pains, anorexia, and great weakness of the extremities. The patient had no fever but suffered from insomnia. A painful flaccid paralysis of the legs soon developed, accompanied by ataxia. Reflexes were abolished. The patient could maintain a sitting posture with difficulty and was unable to walk. The paralysis next involved the diaphragm and thorax.

On September 29 she entered the hospital. There was complete paralysis of the inferior extremities and bilateral facial paralysis. Sensation was intact. There was absence of response to electricity and there were reactions of degeneration, with embarrassment of respiration; consciousness was not affected.

On September 29 she became comatose and died. Nephritis was found at autopsy. Three rabbits were inoculated intracerebrally with the cord and medulla and all remained well. In the spinal cord there were found the lesions of an acute transverse myelitis. No Negri bodies were found.

The similarity of the two cases is at once apparent, and particularly so in the time elapsing between the bite and beginning of treatment and the date of onset of symptoms.

The belief that such paralyses are due to street virus infection (atypical or abortive rabies) seems to be gaining ground in certain European countries, though it seems well established that not all cases are caused in this manner. I have knowledge of an unreported case of treatment paralysis developing in a physician who was not exposed to street virus infection. While administering the treatment to a patient he accidentally stuck his finger with the needle of a syringe containing emulsion of fixed virus that had dried only one day. As some advised him to take the regular course of treatment, and none advised against it, he decided to take the treatment. He later developed paralysis similar to other cases of treatment paralysis, and ultimately recovered. Similar occurrences are reported in the literature.

The exact incidence of this paralysis in treated cases can not be determined as, without doubt, all cases are not reported. Remlinger,[2] in 1905, collected 40 cases out of 107,712 cases treated; 2 of

[1] Babes, V., and Mironescu, T. Compt. Rend. Soc. de Biologie, vol. 64, 1908, p. 964.
[2] Remlinger, P. Annales de l'Institut Pasteur, 1905, v. 19, p. 625.

these resulted fatally. Stimson [1] stated, in 1910, that subsequent reports had brought this total up to 76 cases, with 4 deaths.

Simon,[2] in 1913, published data showing the occurrence of 100 cases of paralysis in 217,774 treated and 3 other cases, which did not indicate the number treated, occurring up to and including 1911. In this series there were 19 deaths.

Kozewaloff,[3] in 1914, reports 2 more cases not mentioned by Simon, which occurred in the Pasteur Institut at Charkow, and mentions 5 cases observed by Mucharinski and 1 case by Abramov. Higier [4] reported 1 fatal case in 1912. Later Sterling [5] reports 2 cases showing the usual paralytic symptoms and refers to another case of Hudovernig [6] which developed a chronic polyneuritis.

Jochmann [7] reports 3 additional cases, and Goldberg and Oczewalski [8] have recently published a case, in which the picture of meningitis was most prominent, which resulted fatally.

These cases bring the number given by Simon (103) up to 119. Simon's figures do not contain the case of Fabricius.[9] Since the publication of Simon's article I have reported 2 cases and now add 2 more. Park and Williams,[10] in their book Pathogenic Microorganisms, state (p. 585) that there have been 7 cases of this paralysis, with 2 deaths, in 6,850 cases treated at the Pasteur Institute of the New York City health department. I also have knowledge of 2 other cases, as yet unpublished, bringing the total up to 133 cases, of which 25 have resulted fatally.

As the recent articles have not all given the total number of patients receiving treatment, the incidence of the disease can not be fully determined. Simon's figures, 100 cases in 217,774 persons treated, are the latest ones available (1 case in 2,177 treated persons). Probably many cases are not reported, so the true incidence of the paralysis would be greater than indicated by the figures.

These figures are given to aid physicians and health officers in advising prospective patients of the possible ill effects of antirabic treatment. When the figures are compared with those of cases that develop rabies after being bitten by rabid dogs and have not taken antirabic treatment (about 15 per cent, Döbert [11]) and those of cases that develop rabies in spite of treatment (0.50 per cent) and taking into consideration that practically 100 per cent of de-

[1] Stimson, A. M. Bull. No. 65, 1910, Hyg. Lab.
[2] Simon, Gerhardt. Centralbl. f. Bakteriol. Jena, Orig. Bd. 68, 1913, pp. 72-112.
[3] Kozewaloff, S. Centralbl. f. Bakteriol. Jena, Orig. Bd. 73, 1914, pp. 54-71.
[4] Higier, Heinrich. Zeitschr. f. d. ges. Neurol. u. Psychiat., Orig. Bd. 12, 1912, pp. 353-364.
[5] Sterling, W. Zeitsch. f. ges. Neurol. u. Psych. Orig. Bd. 17, pp. 160-205.
[6] Hudovernig, C. Author's Abstract in Neurol. Centralbl., 1912, Bd. 31, p. 1116.
[7] Jochmann, G. Deutsch. Zeitschr. f. Nervenheilk. Bd. 47 and 48, 1913, pp. 267-295.
[8] Goldberg, J., and Oczewalski, K. Wien. Klin. Wochnschr., 1913, Bd. 26, pp. 1981-1984.
[9] Fabricius, J. R. Archives of Diagnosis, 1909, vol. 2.
[10] Park, W. H., and Williams, A. W. Pathogenic Microorganisms, 1914, p. 585.
[11] Döbert, A. Klinisches Jahrbuch, 1909, Bd. 21.

veloped cases of rabies die, it is plainly evident that the choice of taking antirabic treatment is choosing the lesser of two evils.

From cases reported it seems probable that alcoholism, syphilis, and neurasthenia are factors favorable for the development of these paralytic phenomena; exposure to cold, either by cold bath or by weather conditions, and fatigue are also predisposing causes.

In reporting these cases the object has been twofold: To record cases of scientific interest, and to bring to the attention of physicians and people generally the fact that it is far safer to prevent the exposure of man to possible infection of rabies than to rely on antirabic treatment to prevent the development of the disease after exposure. Though the treatment is usually without ill effects, all patients should know of the possible occurrence of complications, so that they can determine for themselve whether or not they, desire to receive the treatment. It is the duty of physicians or officials to give this information to prospective patients.

PLAGUE-PREVENTION WORK.

CALIFORNIA.

The following report of plague-prevention work in California for the week ended July 10, 1915, was received from Passed Asst. Surg. Hurley, of the United States Public Health Service, in temporary charge of the work:

San Francisco, Cal.

RAT PROOFING.

New buildings:	
Inspections of work under construction.	166
Basements concreted (square feet, 7,090).	24
Floors concreted (square feet, 2,236)....	4
Yards, passageways, etc. (square feet, 2,782).....	15
Total area of concrete laid..square feet..	12,108
Class A, B, and C (fireproof) buildings:	
Inspections made.....	183
Roof and basement ventilators, etc., screened.....	5,105
Wire screening used.....square feet..	24,260
Openings around pipes, etc., closed with cement.....	8,248
Sidewalk lens lights replaced.....	900
Old buildings:	
Inspections made.....	375
Wooden floors removed.....	17
Yards and passageways, planking removed.....	2
Cubic feet new foundation walls installed	3,175
Concrete floors installed (square feet, 72,621).....	38
Basements concreted (square feet, 10,625)	21
Yards and passageways, etc., screened (square feet, 4,557).....	17

RAT PROOFING—continued.

Old buildings—Continued.	
Total area concrete laid ...square feet..	87,803
Floors rat proofed with wire cloth (square feet, 820).....	2
Buildings razed.....	2
New garbage cans stamped approved.....	725
Nuisances abated.....	76

OPERATIONS ON THE WATER FRONT.

Vessels inspected for rat guards.....times..	27
Reinspections made on vessels.....	19
New rat guards procured.....	5
Defective rat guards repaired.....	9
Rats trapped on wharves and water front..	30
Rats trapped on vessels.....	12
Traps set on wharves and water front.....	179
Traps set on vessels.....	58
Vessels trapped on.....	11
Poisons placed on water front.....pieces..	3,600
Bait used on water front and vessels, bacon .....pounds..	6
Amount of bread used in poisoning water front.....loaves..	12
Pounds of poison used on water front.....	6